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# AHP-Based Capacity Evaluation of Enterprise Development

Ting Wang*, Bing chuan Xin, Li juan Qin

*Department of Economic Management*
*North China Electric Power University, Baoding, 071003*
*Baoding Hebei China*
Xin123183@163.com

**Abstract**

the capacity of enterprise development is the base of enterprise existence and the springhead of profit. The paper will incorporate a variety of single index that reflects the capacity of enterprise development into an organic system based on AHP, and thus show a full range of comprehensive description of the capacity of enterprise development. Finally , proved the validity of the model through a case.



Key words: enterprise; development capacity; AHP method

## 1.Introduction

Enterprise development capacity, also known as business growth, i.e. the accumulating development potential through the production and operation activities. Evaluating the capacity of enterprise development has a very strong practical significance to improve business management and market competitiveness. However, when analysis the capacity of enterprise development, people faced with an interrelated and mutually conditioned complex system composed by many factors, and coupled with each single factor index reflects only one aspect of the development capacity of enterprises, thus it is difficult to make a comprehensive, objective conclusion in general. AHP is characterized by the hierarchical, quantitative factors to the complex decision problem, and quantitative decision-making basis by mathematical methods. And combined with evaluation index system of enterprise development, a simple and practical way to address the above problem was provided.

## 1. About AHP

AHP is a combination of qualitative and quantitative, multi-criteria decision making method. Combined with business development capacity analysis, AHP method follows these steps:

### *2.1. Designing evaluation index and establishing hierarchy structure*

Selecting reasonable evaluation indexes is the basis to correctly evaluate enterprise development capacity. Thus the designing of indexes is key link. By Science, objectivity, rationality, feasibility and other guiding principles, the paper selected the credibility of enterprises development, the level of capacity growth, the proportion of technical inputs and the level of earnings growth, four aspects to analysis the capacity of enterprise development, and each aspect is also subdivided into a number of indicators. And structured the AHP model at the same time, in order to make the problem organized, hierarchical. As following table:

* Corresponding author. Tel.:+8613191675297
E-mail address: 1035952297@qq.com

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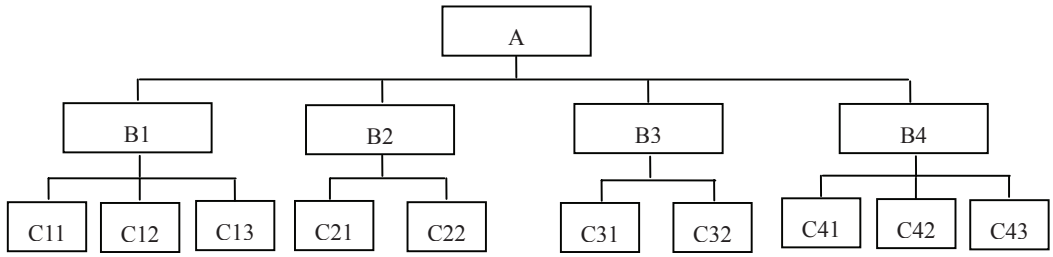
Table 1. AHP chart of enterprise development capacity




A: Comprehensive evaluation of enterprise development; B1: The credibility of enterprise development; C11: Current ratio; C12: Quick ratio; C13: Asset – liability ratio; B2:The level of capacity growth; C21: Ratio of capital accumulation; C22: Capital maintenance and appreciation; B3: The proportion of technical inputs; C31: Proportion of R&D investment; C32: Proportion of training expenditure growth; B4: The level of earnings growth; C41: Revenue growth; C42: Operating profit growth; C43: Net profit growth.

### *2.2. Judgment matrix construction*

After the AHP model established, compare the elements of each hierarchy, and structure the comparison matrix. The value of judgment elements reflects the relative importance, Generally use the 1-9 scale and the bottom scale method.

Table 2. Judgment matrix scale and the meaning

| Cij evaluation | Meaning |
|---|---|
| 1 | Element i and j are equally important |
| 3 | Element i is slightly important than j |
| 5 | Element i is obviously important than j |
| 7 | Element i is intensely important than j |
| 9 | Element i is extremely important than j |
| 2, 4, 6, 8 | 2, 4, 6, 8 means the value of adjacent judgment respectively |

### *2.3. single hierarchical arrangement and consistency test*

In theory, the problem of single hierarchical arrangement can be attributed to the calculation of the characteristic root and the eigenvector of judgment matrix. Take the square-root method as the example:

a. Calculate the product of the elements each row of the judgment matrix, $M_{\mathrm{i}}$

$$M_{\mathrm{i}} = \prod_{\mathrm{j}=1}^{\mathrm{n}} \mathrm{a}_{\mathrm{ij}} \quad \mathrm{i} = 1,2\cdots,\mathrm{n}$$

b. Calculate the n-th root $\overline{W_i}$ of $M_i$

$$\overline{W_i} = \sqrt[n]{M_i}$$

c. Normalized vector , $\overline{W}$ ,

$$\overline{W} = \left[\overline{W_1}, \overline{W_2} \cdots, \overline{W_n}\right]^T$$

$$W_i = \frac{\overline{W_i}}{\sum_{j=1}^{n} \overline{W_j}}$$

$W = [W_1, W_2 \cdots W_n]^T$ ,is the eigenvector.

d. Calculate the maximum eigenvalue of the judgment $\lambda_{max}$

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW}$$

In AHP, introduced the negative mean value of the rest of the characteristic root outside the maximum characteristic root, to measure the deviation from the consistency of the indicators of the judgment matrix. i.e.

$$CI = \frac{\lambda_{\max} - n}{n-1}$$

The larger of CI, the greater degree of deviation to the complete consistency of the judgment matrix. And the smaller of CI, the better consistency of the judgment.

In order to determine whether the different order matrix achieve the satisfied consistency, we also need to introduce average random consistency index RI. 1-7 order of judgment matrixes, the value of RI are listed in table 3, as follow:

Table 3. Average random consistency index RI

| N | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| RI | 0 | 0 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 |

And calculate the random consistency ratio, CR=CI/RI, When CR＜0.1, the consistency of matrix is satisfied, otherwise, we need to adjust the matrix, to satisfied the consistency.

### *2.4. General hierarchy ordering*

Calculate the synthesis weights of each layer elements to system goal, and get the general order, to determine the degree of importance of the elements in the bottom layer.

## 3. Application of AHP

The paper collected the data between 2007-2009 related to the capacity of enterprise development about A company, as shown in table 4, then verified the comprehensiveness, authenticity of the basic date. And take A company as an example to analysis its development capacity.

Table 4. The data of A company

| Item | 2007 | 2008 | 2009 | Item | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| Current ratio | 1.51 | 1.70 | 1.82 | Proportion of R&D investment | 0.01 | 0.02 | 0.03 |
| Quick ratio | 0.8 | 1.42 | 1.46 | Proportion of training expenditure growth | 0.3 | 0.2 | 0.1 |
| Asset-liability ratio | 0.52 | 0.71 | 0.66 | Revenue growth | 0.05 | 0.15 | 0.3 |
| Ratio of capital accumulation | 0.11 | 0.08 | 0.13 | Operating profit growth | -0.04 | 0.06 | 0.2 |
| Capital | 1.11 | 1.08 | 1.13 | Net profit growth | -0.05 | 0.05 | 0.18 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| maintenance and appreciation | | | | | | | |

*3.1. Establish hierarchical structure, as shown in table 1.*

*3.2. Construct the judgment matrix, calculate single hierarchical arrangement of each judgment matrix, and the results of the consistency.*

Take the judgment matrix A-B as an example:

$$\begin{bmatrix} 1 & 2 & 2 & 3 \\ 1/2 & 1 & 1 & 2 \\ 1/2 & 1 & 1 & 2 \\ 1/3 & 1/2 & 1/2 & 1 \end{bmatrix}$$

The results of the weight of criteria level and the consistency:

$$W_i = (0.4236, 0.2271, 0.2271, 0.1223),$$

CI=0.0035, CR=0.0039＜0.1 passed the consistency test

*3.3. Use the same method; we get the index weights for the third layer*

$$W = (0.229, 0.1\,27, 0.068, 0\,.114, 0.114\,, 0.114, 0.0\,13, 0.071, 0\,.038)$$

*3.4. At last, calculate the comprehensive index value of the enterprise based on the relative weights and the actual value of the indexes*

The index value of the A company in 2007

$$0.229 \times 1.51 + 0.127 \times 0.8 + 0.068 \times 0.52 + 0.114 \times 0.11 + 0.114 \times 1.11 + 0.114 \times 0.01$$
$$+ 0.114 \times 0.3 + 0.013 \times 0.05 + 0.071 \times (-0.04) + 0.038 \times (-0.05) = 0.65$$

Similarly, the index value of 2008 and 2009 is 0.78 and 0.83. By calculating the value of the comprehensive development index, we can see that the development capacity of the company is strong in 2009, and poor in 2007. But the index value increased year by year for the three years, the company showed a good overall progress momentum.

## 3. Conclusion

Through the introduction of AHP, and the combination with the case, we get the conclusion that AHP is a scientific method to analysis the comprehensive capacity of enterprise development. However, taking into the simplification of the model, the determination of the index system is imperfect to analysis the influential factors about enterprise development, and need to further improved in practice.

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